Basilar Skull Fracture Evaluated Via Computed Tomography*

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Basilar skull fractures and associated avulsion of the musculature (i.e., the rectus and longus capitis muscles) should be considered an important diagnostic differential in horses presenting with epistaxis and/or neurologic signs, even if no traumatic event was witnessed.

Fractures of the cranial cavity can be very difficult to identify via radiography, especially if the fracture is nondisplaced. The enhanced resolution and sensitivity of computed tomography (CT) make it the ideal imaging modality for accurate diagnosis of skull fractures in horses. Increasing numbers of private practices and referral institutions have adapted conventional human CT units to enable high-quality imaging of the head and distal limbs of adult horses. This article describes the clinical, radiographic, endoscopic, CT, and pathologic features of an adult horse with a traumatic basisphenoid skull fracture.

CASE DETAILS

History

A 16-year-old Thoroughbred gelding presented to the Veterinary Medical Teaching Hospital at the University of Wisconsin with a history of a traumatic incident while tied in cross-ties 6 weeks earlier. The horse reacted violently to being bridled while tied and had fallen over backward. The horse remained in lateral recumbency for several minutes before rising. A veterinarian was immediately called to evaluate the horse and reported profuse bilateral epistaxis and bleeding from the patient’s mouth. A large, firm swelling was palpated behind the left mandible. Although the horse’s mentation appeared normal at that time, it was severely atactic in both fore- and hindlimbs. Epistaxis continued intermittently over the next 3 days. The horse received a course of dexamethasone (0.1 mg/kg IV sid every 3 days, for a total of three doses). The ataxia improved somewhat, but clinical signs did not completely resolve. The owners became progressively concerned about the horse’s vision in its left eye, reporting that the horse was bumping into objects on that side and was more agitated when handled from the left side.

Clinical Examination

During admission to the hospital, the horse was alert, responsive, and in good body condition. When backed off the trailer, the horse collapsed on its haunches and displayed a clear lack of proprioception. The general physical examination findings were...
within normal limits, apart from superficial skin wounds over the left eye, left withers region, and left tuber coxa. The patient resented bilateral palpation of the retropharyngeal region, but no swellings were noted in that area.

The ophthalmic examination revealed a decreased menace response of the left eye compared with that of the right eye. The pupillary light reflex, consensual light reflex, palpebral reflex, and corneal reflex were all within normal limits bilaterally. Direct ophthalmoscopy revealed a pale optic nerve with about half the number of retinal blood vessels in the left eye compared with the right eye, which is consistent with optic nerve atrophy.

Neurologic examination revealed hindlimb ataxia that was grade 3 of 5. The horse had a wide rear stance and stabbed the ground with its hindlimbs when trotted in a straight line. When the horse was turned in a tight circle in either direction, the outside hindlimb was circumducted. Grade 1 of 5 forelimb ataxia was also noted. The horse displayed a normal range of neck motion and was able to bring its head around behind the point of its shoulder on both sides. However, the patient was unwilling to flex from the poll. Apart from the left-sided optic nerve deficit, no other cranial nerve deficits were noted.

**Clinical Pathology**

The results of a hemogram and complete serum biochemistry profile conducted during admission were within normal limits.

**Radiography**

On skull radiographs, a ventrally displaced basisphenoid fracture was present (Figure 1). The stylohyoid bones were normal, as were the temporomandibular joints and mandibular condyles.

**Endoscopy**

Endoscopy revealed ventral deviation of the dorsal pharyngeal wall. Within both the left and right gullet pouches in the medial compartments, there were swellings in the medial wall, with roughened gullet pouch mucosa. No blood clots were present in either pouch during scoping. The internal and external carotid arteries and maxillary artery were not involved with the lesion. The stylohyoid bones appeared to be normal.

**Computed Tomography**

Because of a poor prognosis for return to full athletic function, the owners elected for the horse to be euthanized, after which the head was disarticulated from C5 to C6 so that CT images, using a third-generation CT scanner (GE Hilight Advantage System, GE Medical, Milwaukee), could be immediately acquired. The head was positioned in ventral recumbency with the image plane perpendicular to the sagittal plane of the head and the occlusal surface of the cheek teeth. Transverse 5-mm contiguous slices of the head were obtained. Window width and level were adjusted, as necessary, to obtain the optimal image for the cranium, brain, and gullet pouches.

The CT scan confirmed the ventrally displaced fracture of the basisphenoid bone (Figure 2). A soft tissue mass was also present, which was consistent with a hematoma between the gullet pouches containing the fracture fragment. The stylohyoid bones and temporomandibular joints were normal on the CT scan, confirming the interpretation of the radiograph.

**Necropsy**

During necropsy, the only abnormalities were associated with the head. There was subcutaneous hemorrhaging around and in the left orbit and intramuscular hemorrhaging of the dorsal capital straight muscles. A 5-cm fragment from the basisphenoid bone was displaced. Approximately 1.5 cm ventral to the bony defect, between the gullet pouches, there was a 5 × 3 × 4-cm hematoma containing the bone fragment and a necrotic center (Figure 3). There were multiple brain contusions with areas of hemorrhage, malacia, and atrophy. Microscopic examination confirmed...
traumatic encephalopathy and revealed ocular traumatic retinopathy.

**Assessment**

The diagnosis of avulsion fracture of the basisphenoid bone with avulsion of a portion of the longus capitis muscle was confirmed. A consequential hematoma containing the ventrally displaced fracture fragment was present in the retropharyngeal space between the gullet pouches.

The associated ophthalmic diagnosis was hemianopsia of the left eye caused by optic nerve atrophy secondary to trauma.

**DISCUSSION**

This horse presented with history and physical examination findings typically associated with basilar skull fracture. In this condition, there is often a traumatic incident in the horse’s history, most commonly involving the
Case Presentation: Basilar Skull Fracture Evaluated Via Computed Tomography

horse falling over backward. Severe epistaxis and neurologic deficits are the main presenting clinical signs. Both of these were present in this case. In addition, acute cases often involve a mass (i.e., a hematoma between the guttural pouches) in the retropharyngeal region within Viborg’s triangle as determined by ultrasonography. The horse in this case had a mass in this area when examined by the referring veterinarian. Pain during palpation and movement of the retropharyngeal region, consistent with that in this horse, has also been reported. During presentation to our hospital, the horse still resented ventroflexion of the neck, which was consistent with the confirmed injury to the longus capitis muscle.

When a horse falls over backward, the point of impact is the poll. At that point, the ventral neck muscles are tense because of traction forces applied to the base of the skull by the rectus and longus capitis muscles. The pull of the muscles is opposed by the weight of the head.

G—Lateral guttural pouch
H—Stylohyoid bone
I—Tympanic bulla
J—Normal location of the basilar part of the basisphenoid bone
K—Hematoma
L—Condylar process of the mandible
M—Ramus of the mandible
as the momentum of the fall forces the head and neck to hyperextend at impact.\(^1\) The avulsion fracture of the bone occurs at the weakest point, which is the insertion of the muscles at the basisphenoid and basioccipital bones. This area is also weak because there is no lateral support at the foramen lacerum.\(^3\)

Hemorrhage occurs from the rupture of flexor muscles and their associated vasculature.\(^2\) Blood accumulates in the retropharyngeal space and leads to formation of the hematoma. Hemorrhage also occurs from the vasculature and venous sinuses associated with the roof of the guttural pouch and from the disrupted medial wall of the guttural pouch.\(^2\) Bone fragments can also penetrate the guttural pouch, allowing retropharyngeal hemorrhage to enter this region.\(^1\)

Treatment should consist of corticosteroid administration to decrease edema or inflammation and associated ataxia caused by trauma to the central nervous system. Antibiotics may prevent secondary infection of the hematoma, especially through the disrupted guttural pouch mucosa. Strict stall confinement for 4 to 6 weeks is recommended as well as close observation for signs of further hemorrhage or dyspnea from laryngeal or pharyngeal compression.\(^2\)

Fractures involving the cranial cavity have a poor prognosis, and those involving the basioccipital and basisphenoid bones are associated with high morbidity and mortality rates.\(^4\) There are a few case reports of horses with basisphenoid fractures. In a report\(^2\) involving three horses, the outcome differed, as did the initial presenting signs. A horse with epistaxis but no neurologic signs recovered fully and returned to work. Another horse with ataxia and epistaxis recovered but remained mildly atactic. The third horse presented only with epistaxis and appeared to improve but died from acute epistaxis.\(^2\) In a single case report,\(^5\) a horse presenting with severe neurologic signs was euthanized immediately after diagnosis. In addition to the development of epistaxis and ataxia, two other horses developed dysphagia with aspiration pneumonia\(^6\) and colic\(^7\) as sequelae. Return to athletic function has seemed to be influenced by the severity of neurologic signs.\(^2\)

The location and extent of lesions in the head region are difficult to determine by clinical and radiographic examination.\(^8\) Survey radiography can help define skeletal trauma involving the basilar region of the head, but superimposition of complex skull anatomy combined with the clinician’s inherent inability to discriminate small differences in tissue density limit the use of radiography.\(^9\) The transverse images obtained with CT allow complex anatomic structures to be visualized without superimposition of structures. Image contrast and latitude can also be manipulated. Radiographs of the basisphenoid and basioccipital bones are particularly hard to evaluate and are easily misinterpreted because the suture line between these two bones remains open until 5 years of age, according to one source.\(^10\) Even once the suture line has closed, it may appear irregular in shape and width.\(^3\) This makes it very hard to visualize a basilar skull fracture using radiography, especially if it is nondisplaced. Some authors\(^3\) have concluded that considerable displacement must occur before a diagnosis of fracture can be made by radiography. Although endoscopy of the guttural pouches can be helpful, it does not always result in a diagnosis, especially if the fragment is nondisplaced or the hematoma is not a sufficient size to compress the medial walls of the guttural pouches.

Basilar skull fractures should always be considered in the differential diagnosis for horses with epistaxis and/or neurologic signs. Although radiography and

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**Key Points**

- CT is useful in confirming clinical, radiographic, endoscopic, and pathologic features of traumatic basisphenoid skull fractures.
- CT is an ideal imaging modality in the accurate diagnosis of skull fractures in horses.

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**Figure 3. Lateral section through the cranium at necropsy.** The white arrow indicates the hematoma containing the fracture fragment of the basisphenoid bone. The black arrow indicates the missing portion of the basisphenoid bone.
endoscopy can be helpful in making a definitive diagnosis, CT should be considered the optimal imaging technique for a rapid and straightforward diagnosis. Horses must be anesthetized for CT, but increasingly more referral hospitals and clinics have the proper equipment, including an appropriate support table, to facilitate CT of the distal extremities and head and/or proximal neck of adult horses. A CT image series can provide greater information regarding the extent and severity of a fracture and concurrent involvement of surrounding soft tissues. There are neither prospective nor retrospective data using CT imaging as a diagnostic tool in assessing skull injury in horses, but patients with displaced fractures with significant brain involvement should probably be euthanized. Less severe cases, as identified by CT, may warrant aggressive medical therapy, and these patients have a better chance of recovery, survival, and return to function.

REFERENCES